Exposure to hot and cold temperatures and ambulance attendances in Brisbane, Australia

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Background

The effect of climate change on human health has received much attention, in response to projected scenarios of both increasing and more variable global temperatures. It is important to examine temperature effects to inform public health policy, particularly for major chronic conditions such as cardiovascular and respiratory disease. To date, there has been little research examining the effects of temperature on morbidity, particularly ambulance attendances, and no studies have been conducted in a sub-tropical climate to assess both cold and hot temperature effects. This study therefore examined the relationship between ambient temperature and ambulance attendances in Brisbane, Australia.

Methods

We obtained daily observations of average temperature, air pollutants and ambulance attendances (total, cardiovascular, respiratory and other non-traumatic) in Brisbane, Australia during 1 January 2000 to 31 December 2007 (Figure 1).

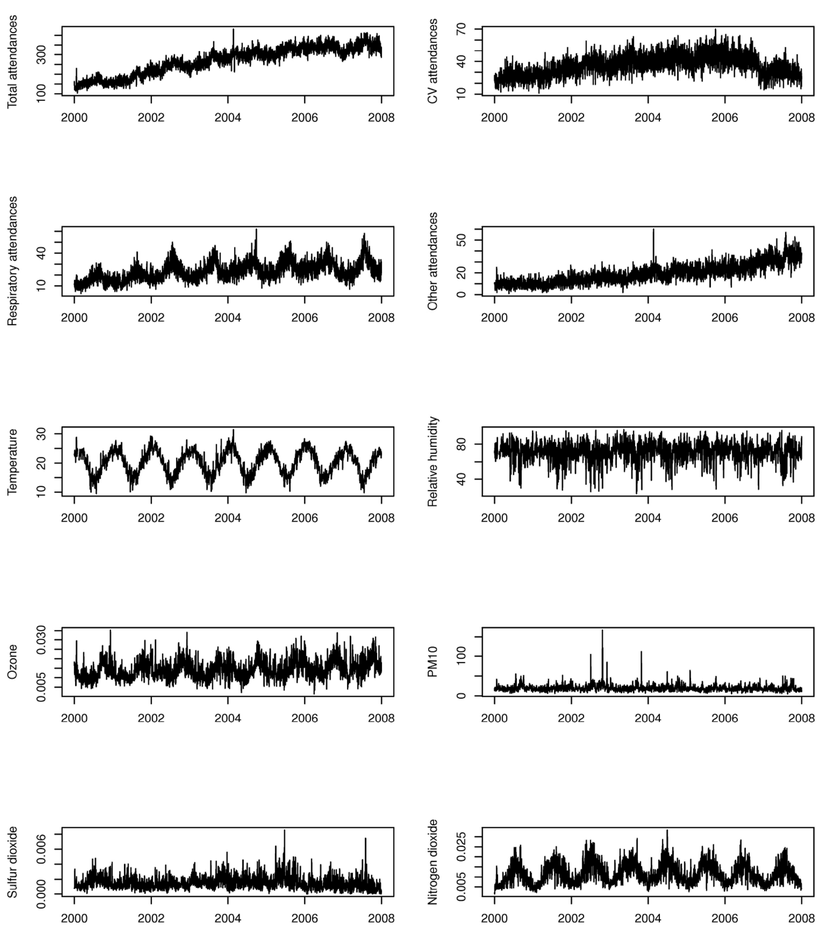

Figure 1: Distribution of ambulance attendance counts, temperature and air pollutants

To examine both hot and cold effects, we applied a Poisson regression incorporating a distributed lag non-linear model. Based on an initial examination of the temperature–attendance relationship (Figure 2), we specified a threshold model for temperature, and estimated a log-linear change in risk of ambulance attendances above (or below) the hot (or cold) threshold/s. To examine the nature of delayed effects of temperature on ambulance attendances, we incorporated lagged effects up to 27 days. Parametric effect estimates were obtained using a lag-stratified approach for the following lag periods: the average of lag days 0–1, 2–15 and 16–27.

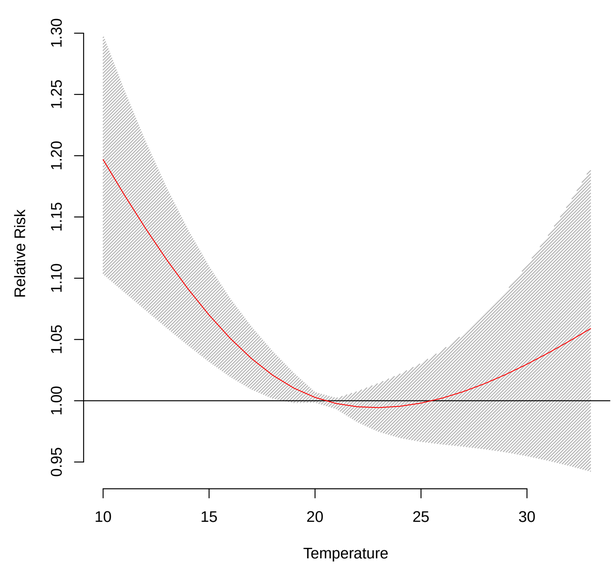

Figure 2: Relationship observed between temperature and ambulance attendances

Results

Significant effects of both hot (a $1\,^{\circ}\mathrm{C}$ increase above the threshold) and cold (a $1\,^{\circ}\mathrm{C}$ decrease below the threshold) temperatures on the number of ambulance attendances were found across all groups (Figure 3). Cold effects were found to be delayed, generally occurring 2–3 days following exposure. The other non-traumatic attendance group was an exception, with effects not occurring until approximately 5–8 days after exposure. The respiratory and other non-traumatic groups also displayed signs of acute cold effects, although these were not statistically significant. Heat effects were found to be acute, occurring within 0–2 days following exposure.

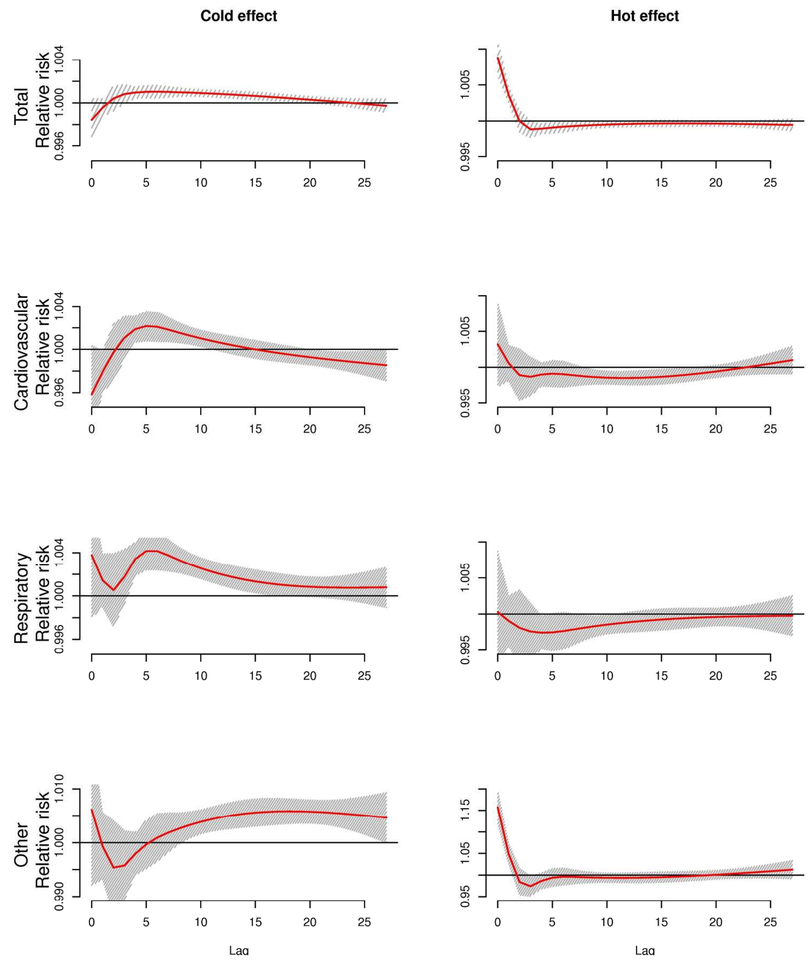

Figure 3: Lagged effects for a $1\,^{\circ}\mathrm{C}$ decrease (left) and increase (right) in mean temperature below (and above) the threshold temperature for total, cardiovascular, respiratory and other non-traumatic attendances

There were significant heat effects over lags 0–1, with the largest heat effect found for the other non-traumatic attendance group (Table 1). We found that heat effects on all groups displayed characteristics consistent with harvesting. Cold effects over lags 2–15 were found for all categories, with no apparent harvesting observed, except for the CV group.

		Attendance category (95% C.I)			
	Lag in days	Total (22 °C)	Cardiovascular (22 °C)	Respiratory (22 °C)	Other (15.5/28 °C)
Heat effect	0–1	**1.17 (0.86, 1.48)**	0.45 (–0.26, 1.16)	–0.38 (–1.40, 0.63)	**20.56 (15.15, 26.10)**
	2–15	**–0.82 (–1.35, –0.30)**	**–1.85 (–3.06, –0.64)**	**–1.99 (–3.72, –0.25)**	–12.37 (–27.06, 2.48)
	16–27	–0.47 (–0.97, 0.04)	–0.35 (–1.51, 0.81)	–0.72 (–2.38, 0.94)	3.19 (–10.30, 16.83)
Cold effect	0–1	–0.16 (–0.40, 0.08)	**–0.62 (–1.17, –0.06)**	0.63 (–0.09, 1.34)	–0.38 (–2.12, 1.38)
	2–15	**1.30 (0.87, 1.73)**	**1.63 (0.64, 2.62)**	**3.65 (2.38, 4.92)**	**3.40 (0.43, 6.37)**
	16–27	0.12 (–0.28, 0.53)	**–1.1 (–2.03, –0.16)**	0.9 (–0.30, 2.11)	**6.49 (3.62, 9.36)**

Table 1: Temperature effects on ambulance attendances in Brisbane, Australia. Effects given as percent change per $1\,^{\circ}\mathrm{C}$ above or below threshold (Threshold stated in brackets for each category)

Conclusion

This study found significant effects of both cold and hot temperatures, and lagged effects of up to 15 days on cardiorespiratory attendances. Examining ambulance attendances rather than admission or mortality data can potentially help to pick up not only early signs of temperature effects, but also effects on health conditions that cannot be examined through analysis of mortality and hospital admissions data. The use of ambulance data in epidemiological research is needed in order to assess a wider range of non-fatal health outcomes, with such analysis particularly useful in the development of more responsive early warning and health surveillance systems.

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